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structural wire grid formed with rigid rods. The plurality of controllably isolated or joined fiber or tow layers formed in 3-D fabrics provide particularly valuable opportunities, well beyond that of 2-D fabrics, for the development of elaborate functional systems, circuits, or networks as is so often done with multi-layer integrated circuits or multi-layer hydraulic manifolds. The very regular, inherently periodic nature of 3-D orthogonally woven and other 3-D fabrics, which are mentioned here as examples, allows them to perform functions similar to those of 3-D grids, arrays or networks. Examples of such functions include phased array emission/detection, shielding or refraction or diffraction of a known wavelength, damage and delamination detection, resin flow and cure rate control, acoustic emission signal sensing, active control of shapes, vibration suppression, supply or transmission of fluids to mention a few.

Optical fibers and sensing devices associated with them are one desirable means for producing smart structures. Optical fibers are available in small diameter; they are flexible, relatively light, relatively strong, relatively inert to environmental degradations, are not affected by electromagnetic influence, carry no electrical current. They can be quite easily adhered to surfaces of materials like metals, ceramics, plastics, composites, or embedded within thereof. When applied to composite structures in the past, optical fibers have been commonly bonded to the exterior or embedded between layers of prepreg without adversely affecting structural integrity. The optical fiber can be embedded in any curable, moldable, or laminated composite material without significantly disrupting the regular manufacturing process. While embedded into the structure, optical fibers neither significantly affect the mechanical characteristics of the composite nor concentrate mass at a particular location along the structure. Advantages